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Removal of azo dyes in aqueous solutions using magnetized and chemically modified chitosan beads (Article)

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Abstract

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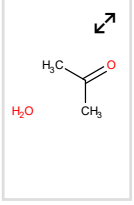
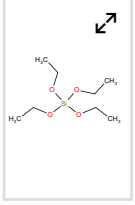
Azo dyes in wastewater coming from textile industry are detrimental, toxic, and affect the human health; therefore efficient wastewater treatments are needed. To contribute to the solution to this problem, in this paper materials based on chitosan beads are studied. Magnetized chitosan beads (MC), MC coated with tetraethyl orthosilicate TEOS (TMC) and MC modified with TEOS and ethylenediamine (ETMC) were synthesized and tested as adsorbents for the removal of two azo dyes: Cibacron Brilliant Yellow 3G-P (CBY) and Cibacron Brilliant Red 3B-A (CBR) in aqueous solutions. The materials were characterized by FTIR, VSM, Raman, SEM, EDX, TGA and XRD. During the adsorption of CBY and CBR dyes in aqueous solutions using the MC, TMC and ETMC beads, it was found that the maximum adsorption capacity (Q_m, $mg.g^{-1}$) of the chitosan beads occurred at pH 2 for both azo dyes. The equilibrium experiments for adsorption of CBY fitted well with the Langmuir isotherm model, whereas the CBR adsorption fitted well with Freundlich isotherm model. The maximum adsorption capacity of the ETMC beads was 179.45 $mg.g^{-1}$ for CBY, and 377.60 $mg.g^{-1}$ for CBR. The adsorption kinetic data of CBY and CBR using the MC, TMC and ETMC beads were better adjusted by the pseudo-second-order kinetic model. The results of the competitive adsorption test for a binary mixture (ratio = 1:1 of CBY:CBR in the mixture) indicated that the ETMC beads recorded the best removal efficiency of the CBY dye (99.1%). Our results indicate, the ETMC material is a promising adsorbent for optimal removal of azo dyes in aqueous solutions. © 2020 Elsevier B.V.

Chemistry database information

Substances





magnetite

Author keywords

Adsorption | Chitosan beads | Cibacron brilliant red 3B-A | Cibacron brilliant yellow 3G-P | Ethylenediamine | Magnetite | Tetraethyl orthosilicate

Indexed keywords

Engineering controlled terms: Adsorption | Azo dyes | Binary mixtures | Chitosan | Dyes | Isotherms | Textile industry | Wastewater treatment

Engineering uncontrolled terms: Adsorption capacities | Chemically modified chitosan | Competitive adsorption | Freundlich isotherm model | Langmuir isotherm models | Pseudo-second-order kinetic models | Removal efficiencies | Tetra-ethyl-ortho-silicate

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